E/CONF.39/B/13
3 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: B.1

Sweden

NEW DEMOGRAPHIC TECHNIQUE FOR STUDYING DEMOGRAPHIC-ECONOMIC-SOCIAL INTERRELATIONS, INSTRUMENTS FOR PROJECTIONS AND DEVELOPMENT PLANNING

By Professor Hannes HYRENIUS,
Demographic Institute,
Department of Statistics,
University of Gothenburg,
Sweden

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

New demographic technique for studying demographic-economic-social interrelations, instruments for projections and development planning

No. 559

B.1.

By Professor Hannes Hyrenius
Demographic Institute, Department of Statistics,
University of Gothenburg, Sweden

1. Introduction

It is generally agreed that there exists a great variety of relations between the composition and changes in a population and the structure and changes in its economic and social life and cultural conditions. Some of these relations are simple one-way causal relations, such as the influence of poor housing upon health, on working capacity and possibly on mortality. An example of causal influence of population on economic factors is the variation in the composition of demand for different types of goods and services following a variation in the rate of natality.

The majority of relations in which demographic factors occur are, however, complex and may preferably be called demographic interrelations (more completely: demographic-economic-social interrelations). The direct causal influence of different factors is usually unclear. The influence is often two-way or it may operate through a number of other factors. As an example the following may be mentioned. Infant mortality can be expected to decrease when poor housing conditions in an area are improved; but it is probable that the mortality is already falling, in part because of several other factors, which themselves also caused this improvement in housing and building of new homes.

Knowledge of these interrelations can be considered the center of demographic interest and efforts. Penetrating, reliable and pertinent information about them will offer good and necessary instruments for forming a better world, in local work, on governmental level and internationally.

Unfortunately, our present knowledge about demographic interrelations is poor and unsatisfactory even in countries with well-developed statistical systems. The reasons for this are several. One is the complexity of many variables involved in a system of both straightforward relations and multivariate interrelations. Another reason is that, whenever economic factors are involved, monetary and other economic changes usually tend to obscure the effects upon the demographic changes as well as the consequences arising from these latter changes.

Even where reliable, informative and detailed statistics are available and one can estimate certain relations of bivariate and multivariate types, with elimination of the disturbances from specific factors, the knowledge will be far from sa-

tisfactory. The causal relations cannot automatically be assessed by means of traditional statistical analysis. Special methods of analysis and a thorough factual knowledge of the demographic-economic-social conditions therefore become necessary.

The main reason for our unsatisfactory knowledge about demographic-economic--social interrelations lies in the fact that we are concerned with situations and changes of a non-experimental character. Human activities, behavior and relations cannot be studied with an experimental approach.

While experiments mean repeated observations under conditions where only one or a few controlled variables are allowed to vary, it is necessary in non-experimental situations to take such observations of variable-constellations as it is possible to obtain. The interpretation of available statistical data therefore becomes difficult, uncertain and/or systematically biased; sometimes a statistical analysis cannot be undertaken at all as no quantifications are possible.

Several ways and methods have been suggested for revealing the interdependence in non-experimental situations. Thus, for example, great efforts are being made to develop so-called econometric models to represent the main structure of economic life. The idea of "model-building" should in principle be useful in all kinds of social research and seems especially suitable for studies of demographic-economic-social interrelations.

The development of electronic computers makes possible a great step forward. We have now at hand, therefore, the means of developing realistic demographic models. This can be done through the combined use of

(a) logical relations concerning certain demographic functions,

(b) available statistical data for estimating demographic and socio-economic functions and parameters, and

(c) electronic computers for handling the large materials and the numerous alternatives for a number of demographic, economic and social factors.

The original purpose of all model-building is to obtain a schematic but realistic picture of the main factors involved. A new feature in model-building is the possibility of simulation offered by means of Monte-Carlo-methods and in other ways. Through these the models can be made to describe more and more closely the real development of the various factors and functions. The simulation approach seems to be essential for obtaining a good grasp of the demographic-economic--social interrelations.

2. Theoretical discussion of demographic models.

The term demographic model may be used for a variety of sets of functions and relations, both with general and with rather specific aims. The models attempt to express functional and other relationships between demographic factors and between demographic, semi-demographic and other factors (such as purely economic, social and cultural). For a more detailed list of factors see below.

Already the first mortality tables constructed during the later half of the 18th century led to what can be considered demographic models. The later work by Bortkiewicz and especially by Lotka led to fruitful results concerning stable populations. A recent step in this direction is the model-construction carried out by the demographic specialists of the United Nations, whereby stable and semi-stable age distributions have been used as a way of forecasting the world population (The

future growth of world population. ST/SOA/Series A/28. UN 1958).

The above-mentioned models are examples of what may be called macro-models as they are based on the average or aggregate conditions with regard to mortality and fertility of a whole population. As micro-models may be characterized such models where the conditions of the individuals are expressed through the single events occurring to them (deaths, births). The individuals can here be considered as the smallest units, but it is also possible to use households or families, firms and organisations as units in micro-models.

As an example of micro-model mention may be made of the Americal study "Micro-analysis of Socio-economic Systems" by Orcutt, Greenberger, Korbel and Rivlin (New York 1961). In this investigation, a miniature population corresponding to the recent census in the United States was constructed comprising 10 000 individuals. These were then subjected to different vital events by the use of random numbers. This was done with a view to obtaining the same average mortality, nuptiality etc. as that of the real population.

The realism of a demographic model can be evaluated by using it for forecasting from one census or sample survey to another. If the model is correct and the quantification by means of available statistics is acceptable, the forecast and the later census should coincide to a degree corresponding to existing errors. To some extent correction can be made for bias; when using electronic computers this can be done by a system of feed-back.

If the model is based on average or aggregate information pertaining exactly to the actual population and period, there should be no deviations due to randomness but only systematic errors. If these are considered too large, the model has to be revised.

The desirability of having the model show random fluctuations can be met by feeding in random disturbances at some suitable points of the model. This can be done by using random normal deviates. With regard to the character of variations in economic and social factors, it seems more realistic, however, to utilize some kind of non-normal disturbances, e.g. random log-normal deviates.

The main purpose of demographic models is the derivation of instruments for studying the interrelations between population trends and structure, economic factors and social conditions. This goal can be obtained only by a step-by-step procedure, starting with the main demographic factors to obtain stable distributions and then taking in other demographic factors and economic and social factors.

The successive development will give new information about different factors involved and about their variations and covariations. It will also be possible to obtain new and better measures of quantitative and qualitative attributes through standardization for certain structural factors. The validity and effectiveness of ordinary methods of population analysis can be tested by the use of demographic models. Finally, improved methods of population projection and forecast will be obtained.

The factors to be included in demographic models can be divided into purely demographic factors on the one hand and semi-demographic factors and socio-economic factors on the other.

A further classification can be made into change factors and structural factors.

To a certain extent there are fixed functional relations between demographic change factors and demographic structural factors. Thus, for instance, the age distribution of a population is exactly determined by the size of cohorts, the mortality and the migration. Some of these functional relations can be expressed mathematically and therefore only need to be quantified. In other factors the relations are too complex to be derived except through numerical estimation of simple marginal distribution, correlations etc.

The following list gives the customary demographic factors and a list of semi-demographic and socio-economic factors. It should not be necessary to explain these in detail. The names of the different factors should be taken to include all the various aspects and versions pertinent to any kind of demographic-economic-social-cultural situation, real or theoretical.

List of factors for demographic models.

Demographic factors		Semi-demographic and socio-economic factors	
Change	Structural	Change	Structural
Mortality	Sex	Morbidity	Health
Nuptiality	Age	Entrance into and exit from labour force participation	Labour force participation
Divorce	Civil status	Invalidization and revalidization	Working capacity/ /status
Fertility	Duration of marriage	Entrance into and exit from industrial branch	Industry
Migration (geographical)	Number of children per individual and per marriage	Entrance into and exit from profession	Educational status
	Urban/rural place of living	Social mobility	Profession and professional training obtained
		School attendance and professional training	Social status
			Income
			Housing
			Ethnic, religious and racial group

3. Notes about current research on demographic models

The quantifications of demographic and other variables and functions to be fed into the models can be made either by observed data, by modified observed data or by purely fictitious values. One important feature of demographic models is that assumed changes in one single factor can easily be evaluated with regard to other factors. If, for instance, the general mortality is assumed to decrease by various amounts at certain ages, due to a reduction in a specific cause of death, the corresponding changes ceteris paribus in the stable age structure, in

the demand for medical care, in the national income etc. can easily be calculated.

The data used in the different approaches now started at the Demographic Institute in Gothenburg have been selected from

(a) Swedish data for recent and pre-industrial periods

(b) data of a number of other countries, less developed as well as industrialized.

For some factors and functions use has also been made of

(c) theoretical constructions and assumptions.

While the first steps in demographic model-building may well be made with ordinary desk equipment, it soon becomes indispensable to use an electronic computer.

The research on models started at the Demographic Institute in Gothenburg is being done with the aid of a couple of computers available for the research work at the University.

The programs are mainly written in the code ALGOL which will allow them to be used on several makes of computers available in other countries. In order to make the work even more accessible it is planned to make the necessary transformations to present the programs also in FORTRAN.

A few words should be said about the testing of programs by making forecasts and comparing the results with factual observations.

This can in principle be done for populations covered by two or more censuses or sample surveys. In the latter case, however, the sampling errors are often so large that the comparisons become meaningless. The censuses, on the other hand, are usually too few, and undertaken at too long time distances and with varying methods and definitions.

Even in countries with fairly good statistical series, a testing of demographic models through forecast-comparisons must be performed with great care. It is considered that Swedish data from the censuses and the registration of vital events are in certain respects accurate and consistent enough for undertaking such testing. This may be said not only about population statistics of recent decades but also about the immediate pre-industrial period.

For special variables where censuses and vital registration are insufficient, it is possible to test the models through specially obtained data on demographic and other characteristics and events. This can fairly easy be done in areas with registrations similar to those at hand in Sweden. Application of the models to the population and the economic and social conditions of a smaller region will give detailed information of great value both to the research on model-building and to the local planning agencies as well. For this reason, the research undertaken at the Demographic Institute in Gothenburg will be tested by means of data for the Gothenburg Metropolitan area.

The research on demographic models at the Demographic Institute is planned to deal with both general model-building and specific questions. Most of the latter will be of relevance to populations of both less developed areas and industrialized countries. Some, however, will be of particular interest for those po-

pulations which are now in the earlier stages of demographic transition.

Below are given a number of specific problems which are included in the research work on demographic models or which can be studied through them. Among the examples, nos. 1 , 2 , 3 , 7 , and 8 are of special interest for analyzing the demographic situation in less developed countries and for development planning in such areas.

Examples of research projects.

1. The reduction of mortality from a specific cause of death affects the general mortality rates differently at different ages. This happens gradually during a period of time. It is desirable to follow how this development gradually affects the stable age distribution and thus all factors in a population and in a society varying with age.

2. An extended educational program causes a delayed entrance into the labour force. On the other hand, improved education and vocational training means increased rates of "climbing in productive categories". By schematic assumptions in this regard, the influence on the national product can be studied as well as changes in the structure of demand for different categories of commodities and services.

3. The improvement in certain diseases means both a reduction in the duration of the sick individuals' withdrawal from work and a reduction in mortality. Both effects have an influence on the national product and on the economic demands

4. The correlation between economic cycles on the one hand and nuptiality and fertility on the other leads to demographic cycles. A great variety of typical situations can be distinguished, of great interest in general and especially for improving methods of population forecasting. Through demographic models it becomes possible to make forecasts with allowance for short-time variations in the various variables and above all with inclusion of economic factors.

5. Improved or worsened economic conditions or changed psychological attitudes may cause more or less permanent changes in nuptiality. This affects the reproduction, the stable age distribution, the demand for homes etc. As a special question one may wish to investigate how much the national product is changed if nuptiality is stimulated through governmental economic measures of a given amount.

6. With reduced infant mortality there follows partly a greater time-distance between successive births. How does this affect reproduction, ceteris paribus?

7. Combinations of different preventive measures, sterilization and legal abortions can be used for obtaining control of population increase. Through models one may find out which possibilities are realistic under various assumptions of effectiveness in the methods, the attitudes of different population groups etc.

8. A rapid spread of knowledge about preventive measures and means may lead to what can be called a "temporarily depressed fertility pattern". This is a possible and perhaps highly probable development in certain less developed areas. Its social, economic and political implications have, however, not been studied, but plans for such a study are being worked out as part of the research on population trends and economic development in less developed countries.

559 E - Oct. 1962 - 1,600